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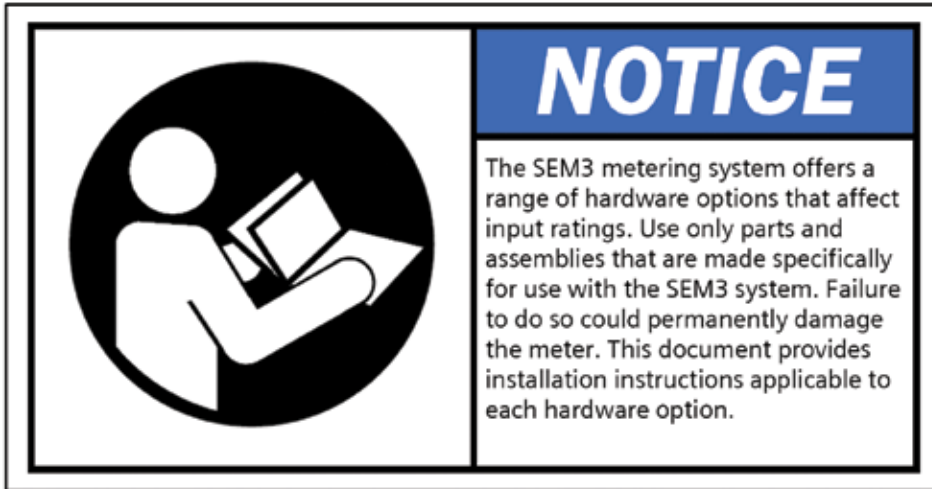


# SEM3™ - Embedded Micro Metering Module™

Installation Manual

Answers for infrastructure and cities.

# SEM3™ - Embedded Micro Metering Module™




## SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local the sales office.


THE CONTENTS OF THIS INSTRUCTION MANUAL SHALL NOT BECOME PART OF OR MODIFY ANY PRIOR OR EXISTING AGREEMENT, COMMITMENT OR RELATIONSHIP. THE SALES CONTRACT CONTAINS ALL OBLIGATIONS OF SIEMENS INDUSTRY, INC. THE WARRANTY CONTAINED IN THE CONTRACT BETWEEN THE PARTIES IS THE SOLE WARRANTY OF SIEMENS INDUSTRY, INC.

## Notices

### DANGER

 This symbol indicates the presence of dangerous voltage within and outside the product enclosure that will cause death or serious injury if proper precautions are not followed.

### CAUTION

 This symbol alerts the user to the presence of hazards that may cause minor or moderate injury to persons, damage to property or damage to the device itself, if proper precautions are not followed.

### Installation considerations

Environmental ratings: Temperature to 14°F to 149°F (-10°C to 65°C). Measurement Category III (CAT III), Mains Supply Voltage Fluctuations up to 10% less than nominal low range the mains supply and 10% more than nominal high range of mains power supply.

Measurement category III is for measurements performed in the building installation. Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, bus-bars, junction



The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions that can cause death, serious injury or property damage.

## IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

## QUALIFIED PERSONNEL

For the purposes of this manual and product labels, "qualified personnel" is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition, s/he has the following qualifications:

- is trained** and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- is trained** in the proper care and use of protective gear equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety procedures
- is trained** in rendering first aid.

boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to the fixed installation.

Installation and maintenance of the SEM3 metering system should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.



Failure to observe the following instructions will cause death or serious injury.

- During normal operation of the SEM3 meter, hazardous voltages are present on its voltage leads, and throughout the connected potential transformer (PT), digital (status) input, control power and external I/O circuits. PT circuits are capable of generating lethal voltages and currents with their primary circuit energized. Follow standard safety precautions while performing any installation or service work (i.e. removing PT fuses).
- The voltage leads to the meter should not be user-accessible after installation.
- Do not use digital output devices for primary protection functions. These include applications where the devices perform energy limiting functions or provide protection of people from injury. Do not use the SEM3 in situations where failure of the devices can cause injury or death, or cause sufficient energy to be released that can start a fire. The meter can be used for energy management functions.
- Do not HIPOT/Dielectric test the digital (status) inputs, digital outputs, or communications terminals. Refer to the label on the SEM3 meter for the maximum voltage level the device can withstand.

- The SEM3 metering system offers a range of hardware options that affect input ratings. Use only parts and assemblies that are made specifically for use with the SEM3 system. Failure to do so could permanently damage the meter. This document provides installation instructions applicable to each hardware option.

## FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Standards Compliance



### • Approvals and certifications

#### – Accuracy

- ANSI C12.1
- ANSI C12.20/0.2

#### – Safety/Construction

- CSA C22.2 No. 1010-1 Safety Requirements for Electrical Equipment for Measurement
- UL916 Energy Management Equipment
- UL61010-1 (IEC 61010-1) Test and Measurement Equipment

#### – Electromagnetic Compatibility

- IEC 61000-4-2 Electrostatic Discharge (B)
- IEC 61000-4-3 Radiated Immunity (A)
- IEC 61000-4-4 Electric Fast Transient (B)
- IEC 61000-4-5 Surge Immunity (B)
- IEC 61000-4-6 Conducted Immunity
- FCC Part 15 subpart B, Class A Digital Device, Radiated Emissions

#### – Environmental Conditions

- Altitude up to 3000 meters
- Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C
- Pollution Degree 3

**Made by Siemens Industry, Inc.**



# SEM3™ - Embedded Micro Metering Module™

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# Chapter 1 – Introduction

## Overview

The SEM3 system is designed to measure the current, voltage, and energy consumption of up to 45 circuits.<sup>1)</sup>

The SEM3 consists of a controller, racks, cables, meter modules and current transformers (CTs) that can be tailored to the application. The CTs are available in solid core versions and are to be mounted along the termination points of each breaker pole being metered. The conductor

passes through the appropriate current sensor before terminating at the breaker. Each CT is terminated into a meter module that in turn is mounted in a rack. The racks get power from and communicate back to the controller through special cables that are part of the SEM3 product line.

The SEM3 has the ability to communicate Modbus RTU via RS485 or Modbus TCP via and Ethernet port to outside systems. Real time values may also be viewed from the controller web pages.

The controller web pages are also used to configure the SEM3 system to the application. Systems info, CT ratio setting and alarms as well as configuring the meter modules into 1, 2 or 3 pole meters are all accomplished through embedded and easy to use web pages. See the SEM3 User Manual for more application specific information at [www.usa.siemens.com/SEM3](http://www.usa.siemens.com/SEM3).

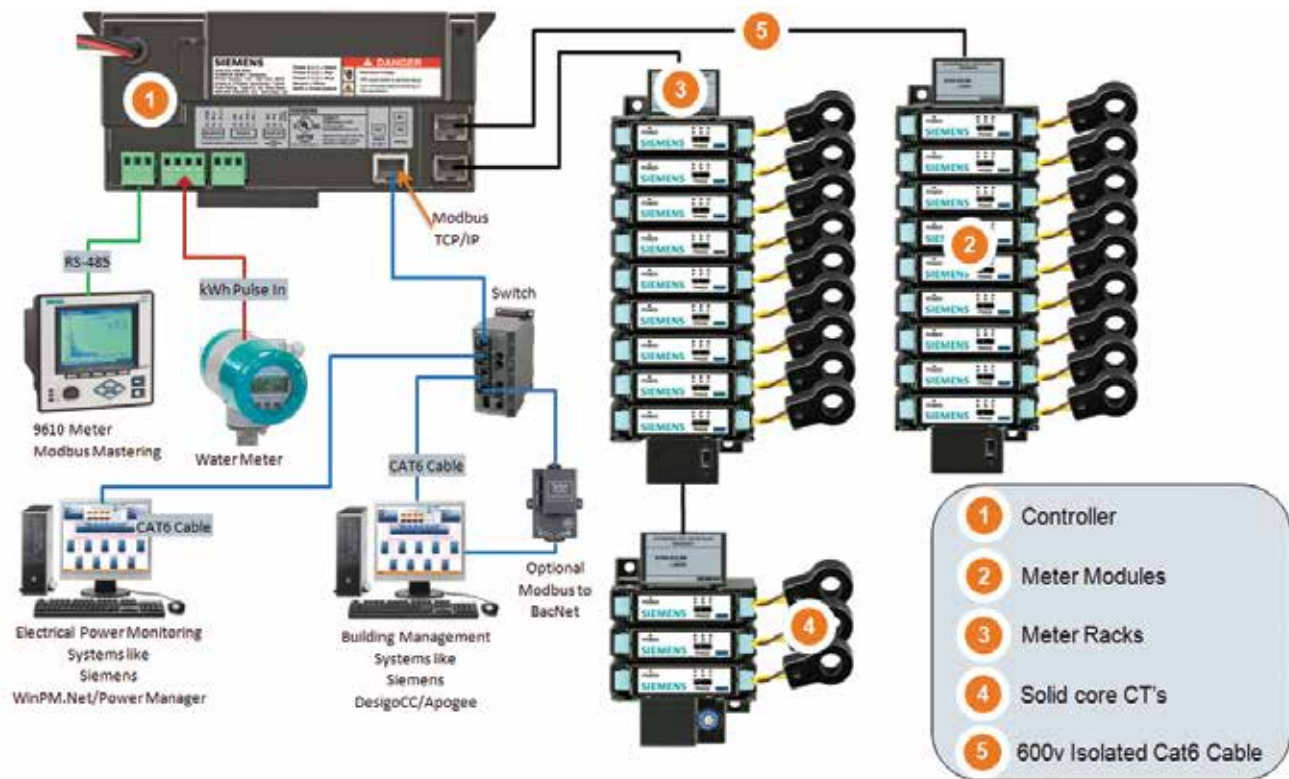


Figure 1 SEM3 Overview Diagram

1) Some applications will allow for more than 45 poles in one enclosure by adding a second controller. Two controllers can monitor up to 90 poles.

# Chapter 2 – Receiving, handling and storage

## Receiving

The SEM3 may be shipped as individual units. Refer to the shipping slip/bill of lading to identify all items included in the shipment.

1. When your shipment arrives, note whether the equipment is properly protected.
2. Make an immediate inspection for visible damage upon arrival and prior to disturbing or removing from packaging.

Note visible damage on the delivery receipt. Take pictures when possible.

3. Notify the Siemens sales office immediately of any damage.

## SEM3 components

- **Current transformers** – solid core CTs in the following maximum ranges 50, 125, 250, 400, 600, 800 and 1200 amps.
- **Meter modules** – 1% standard accuracy modules and 0.2% high accuracy modules<sup>2)</sup>
- **Racks** – 3, 9, 15 and 21 module configurations.
- **Controller**
- **Communication cables**
- **CT supports** – specific to the type of breaker and the CTs they are holding.

All of the above components may be shipped fully assembled in gear. If there are any shortages or damages not previously noted, make certain they are noted on the delivery receipt and contact the carrier immediately. Also, notify the Siemens Sales Office.

## Storage

If the SEM3 components are not installed and energized immediately, they should be stored in a clean dry area where a uniform temperature prevents condensation. Preferably, it should be stored in a heated building, with adequate air circulation and protected from dirt and water. It should be stored where it is not subject to mechanical damage.

If the components are to be stored for any length of time prior to installation, restore the packing for protection during that period. Where conditions permit, leave the packing intact until the components are at their final installation location.

2) 0.2% high accuracy is only possible with Siemens SEM3 Solid Core CTs.



# Chapter 3 – Installation

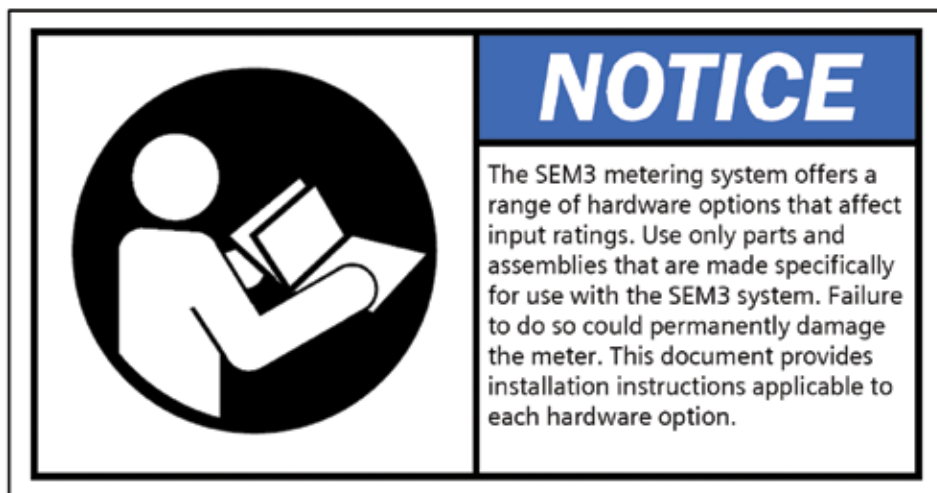
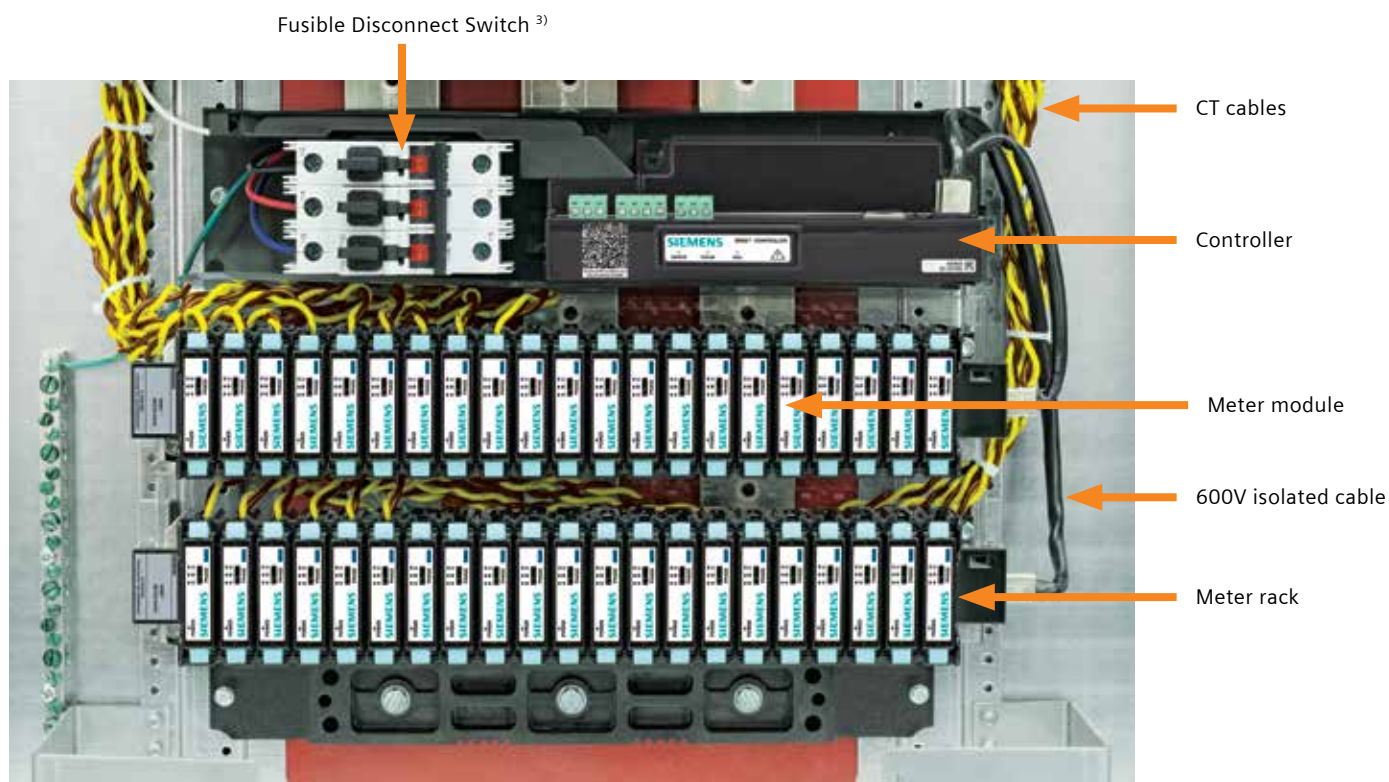


Figure 2 below illustrates Embedded Micro Metering Module components in a panelboard. This is only an example, other applications can apply.



**Figure 2** SEM3™ - Embedded Micro Metering Module™ components in a panelboard

3) The switch or circuit breaker must be marked as the disconnecting device for the meter.  
It is recommended that the meter be mounted near the disconnecting device in an area with adequate ventilation.  
The disconnect should not be positioned in a manner that makes it difficult to operate the disconnecting device.



# Installation (continued)

## Installation

An SEM3 system must consist of at least (1) controller, (1) meter module, (1) current transformer, (1) rack assembly and (1) communication cable. The system can be scaled up using the components up to 45 meter points.<sup>4)</sup>

For complete detail on SEM3 system and configuration, refer to the SEM3 User Manual.

**Note:** Field-installed Class 2, Class 3, and other low voltage conductors shall be separated by a minimum 1/4 inch (6.4mm) from factory- or field-installed electric light, power, Class 1, non-power-limited fire alarm circuit conductors, and medium power network-powered broadband communications cables. Separation of conductors may be obtained by clamping, routing, or an equivalent means.

**Note:** For field installations, the meter shall be mounted inside a UL Listed enclosure. The minimum enclosure size should be no smaller than 18" x 12" x 4".

This is a minimum enclosure size. To include the fusible disconnect and other components, a larger enclosure may be required.

4) Some applications will allow for 63 poles in one enclosure by adding a second controller. Two controllers can monitor up to 90 poles.

# Installation (continued)

## SEM3 Controller

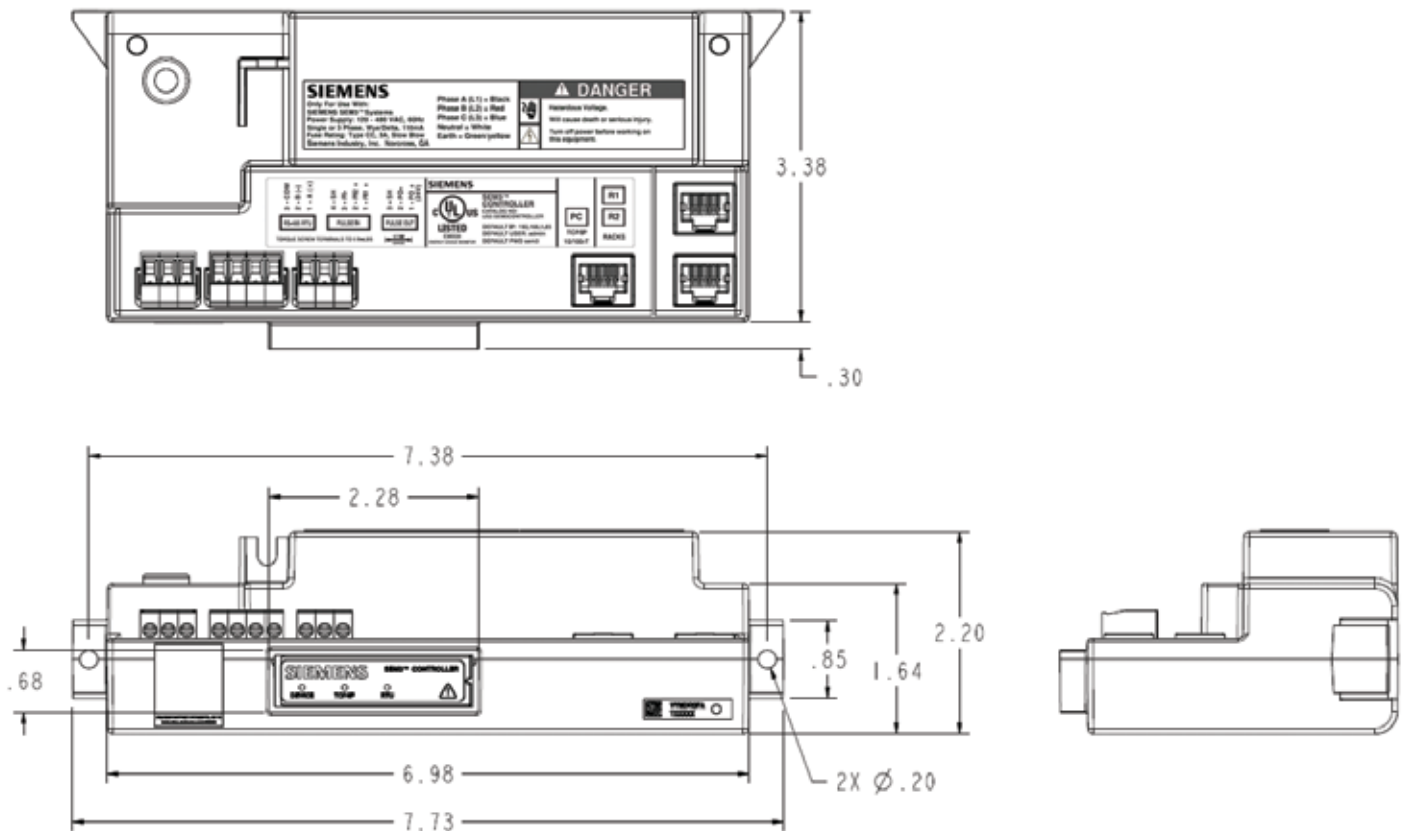
### Catalog number – US2:SEM3CONTROLLER

The SEM3 controller is the heart of the SEM3 system. The controller is to be connected to the voltage source and to the racks and meter modules. All configuration of the system is done via the controller embedded web pages. Refer to the User Manual available at [www.siemens.com/sem3](http://www.siemens.com/sem3) for more information on configurations.

### Mounting

The controller should be securely mounted and protected against damage from power cables. All applicable codes and standards must be observed. The controller has mounting holes at each end that can be used for mounting to a back plane. The controller may be mounted remote to the gear in a separate enclosure.

See Figure 3 for dimensional information.



**Figure 3** Controller dimensions

# Installation (continued)

## Ratings

Power Supply: 120-480 Vac

Frequency: 60 Hz

Systems: Single or three phase systems (Wye or Delta)

Power consumption: 110 mA

Fuse protection: Type CC, 3 A, Time- Delay

## Voltage inputs

The controller has five leads that are color coded and labeled to the appropriate phases and ground connection. All phase (ungrounded ) connections should be protected by a 3 amp fuse or circuit breaker that is appropriate for the applied voltage and available short circuit rating. (Example: a type CC fuse rated at 3 amp (Time-Delay) and good for application on up to a 200 kAIC system at 480 volts).

The SEM3 metering system may be direct connected to any AC system that has a line to line voltage less than or equal to 480 Vac and Line to neutral or ground voltage less than 277 volts. Greater than 480 Vac,

but less than or equal to 600 Vac systems will require PT between the Controller and the supply voltage. See the user manual for more information on setting the meter system for use on 600 Vac systems.

## The Voltage leads are as follows

*For three phase four wire systems –* phase A (line 1) is black in color, phase B (line 2) is red in color, phase C (line 3) is blue in color, neutral is white in color and equipment ground is green (with a yellow stripe) in color.

Where applicable, “connect 14 AWG min., 600 V min. insulated wiring for Line voltages and Neutral to the appropriate locations in the breaker panel, in accordance with all national and local electrical codes”.

*For three phase three wire systems –* phase A (line 1) is black in color, phase B (line 2) is red in color, phase C (line 3) is

blue in color, neutral is white in color is to be removed or tied out of the way and equipment ground is green (with a yellow stripe) in color.

*For single phase three wire systems –* phase A (line 1) is black in color, phase B (line 2) is red in color, phase C (line 3) is blue in color is to be discarded or tied out of the way, neutral is white in color and equipment ground is green (with a yellow stripe) in color.

See the user manual for information on setting the system parameters.

**Note:** Wiring from the controller to the racks, wiring to and from the digital inputs and output are considered Class 2 wiring. Care should be taken to keep these wires and cable separated from power cables per standard requirements. <sup>5)</sup>

**Note:** Connector torque rating for wiring terminals is 5 IN-LBS

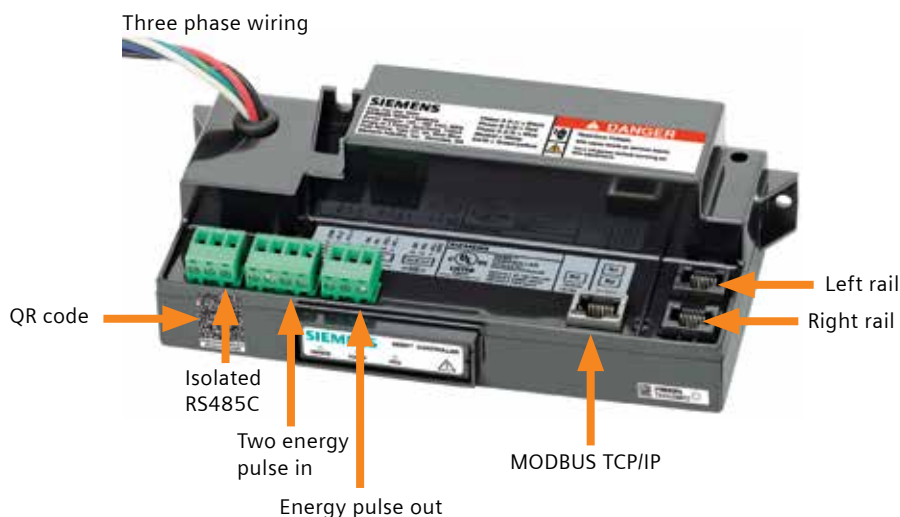


Figure 4 Diagram of front of SEM3 controller

5) Refer to Field-Installation Note on Page 5.

# Installation (continued)

## Rack Assemblies

### Catalog numbers

- 3 position rack – US2:SEM3RACK3
- 9 Position rack – US2:SEM3RACK9
- 15 Position rack – US2:SEM3RACK15
- 21 Position rack – US2:SEM3RACK21

The meter module rack assemblies should be securely mounted to a back plane in an area as to be protected from damage. The meter modules snap into the rack assemblies for mounting. Make sure you have allowed clearance for the meter modules in your selection of mounting areas. The racks are connected to the controller using communication cables.

The communication cables come in varying lengths from 6", 12", 24", and 36". The communication cables are considered Class 2 wiring so routing of these cables also needs to be considered in the location of the rack assembly.<sup>6)</sup>

The rack assemblies have the meter module addressing hard wired into their construction. Dip switches and or rotary switches are provided on the rack to allow each to have unique addressing available for the meter modules. See the user manual for more information on the rack addressing.

Each rack has mounting holes on opposing corners for mounting. See the dimensional drawings below for details.



Figure 5 Four meter rack options with meters snapped inside



Figure 6 Rack dimensions

6) Refer to Field-Installation Note on Page 5.

# Installation (continued)

## Meter Modules

### Catalog numbers

High accuracy – US2:SEM3HAMETER

Standard accuracy – US2:SEM3LAMETER

The meter modules are designed to snap into place in the rack assemblies. There are guides on the module and in the rack assemblies to help insure proper placement of the modules in the rack. If the module is forced into the rack assembly improperly it can damage the meter module and rack. The module should easily fit into the rack assembly and have audible clicking when locked into position. To remove the meter module the release tabs should be pressed together and lift the module straight out of the rack. Refer to the user manual for more information on this setting. See the rack assembly dimensional drawing for sizing of the meter module plus rack assembly.

### Step by step instructions are as follows:

Installing both accuracy levels of SEM3 meter modules into the SEM3 meter rack

1. Connect the appropriately sized SEM3 system CT in the CT wiring terminal. Insure that the CTs leads are firmly secured to the meter module.
2. Snap or place the SEM3 module into an open slot in the meter rack assembly.
3. Note that modules must be mounted contiguously in the racks to be configured for multi-pole circuit breakers. Gaps in the rack will not allow multi-pole meters to be configured as multi-pole meters.
4. Set the phase dip switch on the top of the module to the phase that the CT is metering, phase A, B, or C (line 1, 2, or 3 respectively).

**Note:** Once the meter module is placed into the rack and energized the phase position will be indicated by a different color LED for each position. Colors are orange for phase A (line 1), yellow for phase B (line 2), green for phase C (line 3). LED are adjacent to the phase numbers. The power indication LED also indicates communications by flashing.

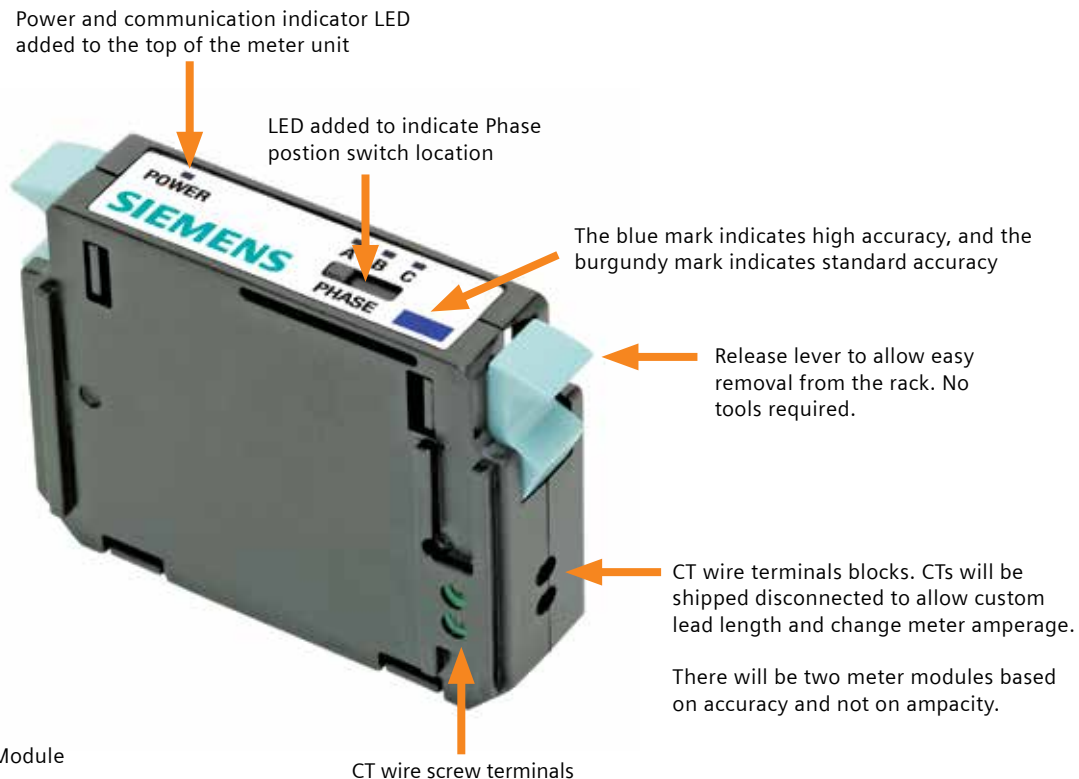


Figure 7 SEM3 Meter Module

# Installation (continued)



Figure 8 SEM3 meter front view



Figure 9 SEM3 meter isometric view

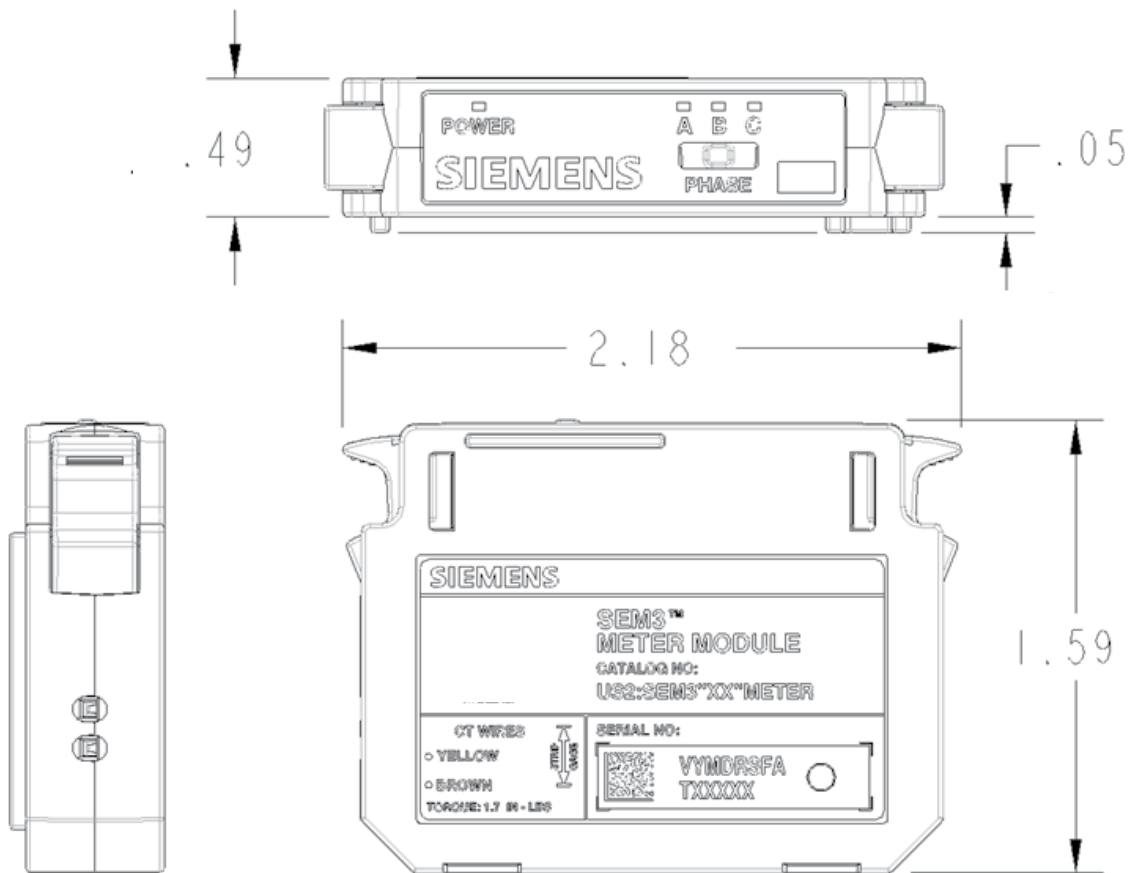


Figure 10 Meter module dimensions



# Installation (continued)

## Current Transformers

The CTs used with the SEM3 metering system are specifically designed and rated for use with the system. Use of other CTs can be damaging to SEM3 components and cause hazardous situations. All the CTs used with this system are in compliance with the most up to date safety standards. Use only UL Listed Energy Monitor Current Transformers, evaluated and approved for SEM3 application. All CTs should be secured within the gear to protect against damage. Size CT primary rating with the load to be measured. The CT primary rating should be equal to or greater than the load.

### Solid core catalog numbers

50:0.1 Solid Core CT - US2:SEM3SCCT50  
125:0.1 Solid Core CT - US2:SEM3SCCT125  
250:0.1 Solid Core CT - US2:SEM3SCCT250  
400:0.1 Solid Core CT - US2:SEM3SCCT400  
600:0.1 Solid Core CT - US2:SEM3SCCT600  
800:0.1 Solid Core CT - US2:SEM3SCCT800  
1200:0.1 Solid Core CT - US2:SEM3SCCT1200

**Note:** For Solid Core CTs, Wire conductors RHH, RHW, and RHW-2 will not be used. (Conductor outer diameter larger than CT inner diameter). Reference NEC 2014 Edition, Table 5, Page 70-761.  
250 KCMIL Max Conductor for 250A CT.

### CT ratings for Solid Core CTs for use with the SEM3 metering system

- 100mA output
- Lead wires are 18AWG, Stranded 16/30
  - Primary Rating: 600VAC
  - Overvoltage Category: CATIII
  - BIL: 10kV, Fullwave
  - Amplitude error:  $\pm 0.2\%$
  - Phase error:  $<0.2$  ( $<12$  Min)
  - Overload rating:  $6 \times I_p$  for 30 seconds

As a reminder, the CTs used with the SEM3 metering system are specifically designed and rated for use with the system. All the CTs used with this system are in compliance with the most up to date safety standards. Use only Siemens SEM3 CTs with the SEM3 system. All CTs should be secured within the gear to protect against damage. Size CT primary rating with the load to be measured. The CT primary rating should be equal to or greater than the load. CTs should be secured using standard practices and follow all codes and standards and are subject to local authorities having jurisdiction.



**Figure 11** Typical Solid Core CT

**Note:** CATIII current transformers are not suitable for use with service entrance conductors. The use of these CTs shall be limited to non-service conductor locations.



### Note:

- CTs should be securely fastened such that they will not slide down to live terminals.
- WARNING - to reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before installing or servicing current transformers.
- In accordance with NEC, CTs may not be installed in any panel board where they exceed 75% of the wiring space of any cross sectional area.

# Installation (continued)

## Communication cables

The communications cables connect the meter racks to the controller and connect meter racks together in series. Multiple lengths are available to suit a wide variety of configurations. Although the cables may look like standard Ethernet cables they are 600V insulated wires but are considered Class 2 wiring. Care should be taken to follow codes and standards for clearance and isolation<sup>7)</sup> of Class 2 wiring from power wiring. Use only SEM3 components with the system. Failure to use SEM3 components from Siemens could cause damage to the product and place the user at risk of or electrical shock or fire.

### Cable catalog numbers

- 6" cable - Controller to rack - US2:SEM3CAB6INCH
- 12" cable - Controller to rack - US2:SEM3CAB12INCH
- 24" cable - Controller to rack - US2:SEM3CAB24INCH
- 36" cable - Controller to rack - US2:SEM3CAB36INCH



7) Refer to Field-Installation Note on Page 5.

# Notes

# Notes

# Notes

**Siemens Industry, Inc.**  
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